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REVIEW OF LICENSE PLATE RECOGNITION (LPR) USING EDGE DETECTION

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ABSTRACT

The detection of license plate region is the most important part of a vehicle's LPR followed by plate segmentation and optical character recognition. LPR is the extraction of vehicle license plate information from an image or a sequence of images. The extracted information can be used in may applications such as intelligent transport system, identification of stolen vehicles, law enforcements, traffic control etc. The proposed methodology consists of five steps- Preprocessing, edge detection, license plate localization, character segmentation, character recognition. Presently, among multiple techniques of image segmentation available, but there is no one single technique that is suitable to all the applications. In this paper, we present a comprehensive review of license plate recognition. Future forecasts of LPR are given at the end.

KEYWORDS: License Plate Recognition, Edge Detection, Vertical Edge Analysis

1. INTRODUCTION

People have been started to pay more and more attention on the advanced, efficient and accurate intelligent transportation systems (ITSs) with the rapid development of highway and the wide use of vehicles. In order to improve the safety and management, countries are studying actively and effectively the automobile license plate recognition system in the world. LPR system is based on MATLAB. It introduces digital camera and computer information management technology in the system. It is fulfilled by the combination of image processing, pattern recognition and artificial intelligence techniques. Ability for computer to process image and translate it into something meaningful has become more popular. Some of applications of such license plate recognition/identification are intelligent transport system, identification of stolen vehicles, vehicular traffic logging, traffic control, automatic toll payment, and law enforcements. Edge detection and morphological operations are used to find vehicle license plate regions. A LPR system generally consists of five processing steps: Preprocessing, edge detection, license plate location, character segmentation, character recognition. This method scans an image and counts the existent edges if the number of the edges is greater than a threshold, then the license plate is recognized; if not, threshold have to be reduced and algorithm will be repeated. This method is fast and has good results for simple images. Although license plate standards vary from country to country. This paper presents a comprehensive review of license plate recognition. This paper is organized as follows: Section 2 represents the problem definition. Section 3 represents the related work. Section4 represents the proposed methodology. Section 5 represents the conclusion and future scope.

2. PROBLEM DEFINITION

Presently, license plates available in the market with different sizes and in different width - height ratios, different color due to non standardization and the fonts used for digitson license plates are different for all license plates. The variations in the license plate types or environment cause challenges in the detection and recognition of license plates.

Previous Work

He presented the image segmentation as a graph partitioning problem and proposed a novel global criterion, the normalized cut, for segmenting the graph. The normalized cut criterion measures both the total dissimilarity between the different groups as well as the total similarity within the groups. He showed that an efficient technique based on a generalized eigenvalue problem can be used to optimize this criterion. He applied this approach to segmenting static images, as well as to motion sequences [2]. Chang et al. (2004) in his study the proposed LPR technique consists of two main modules: a license plate locating module and a license number identification module. He used fuzzy disciplines to extract license plates from an input image and terms of neural subjects aims to identify the number present in a license plate .In his experiment the success rate of license plate location is 97.9% and the identification rate of success is 95.6%.On combining the above two rates, the overall success rate for his LPR algorithm is 93.7% [3]. Hsien et al. (2004) in his article, he present the current research in license plate recognition and elaborate its use in e-Government.

He said License plate recognition has three main components: plate detection, character segmentation and character recognition. He considered all these three components and studied how to apply license plate recognition in e-Government to improve performance [4]. Wenjing et al. (2005) for accurate license plate localization, he presented a region-based algorithm where mean shift is used to filter and segment color vehicle images into candidate regions. In order to decide whether a candidate region represents a real license plate, three features are extracted namely, rectangularity, aspect ratio, and edge density. Then, the Mahalanobis classifier is used to classify license plate regions and non-license plate regions. His results show that the proposed algorithm produces high robustness and accuracy [5]. Safi et al. (2006) in his paper, he describes a system based on image processing technology. System detects and recognizes a license plate of the car registered in NWFP province of the Pakistan. It performs the recognition in almost real-time, watching cars slowing down in front of video recording device. Main feature of the system is using very low cost devices to accomplish this task even in real time [6]. Anagnostopoulos et al. (2006) He proposed a new algorithm for vehicle license plate identification, on the basis of a novel adaptive image segmentation technique (Sliding Concentric Windows-SCW) and connected component analysis in conjunction with a character recognition Neural Network [7]. Faradji et al. (2007) He said license plate location is an important phase in vehicle license plate recognition for intelligent transport systems. His paper presents a robust and real time method of license plate location. In his proposed algorithm the first stage is to extract vertical edges of the input image using Sobel mask. In the next stage, histogram analysis is used for finding the candidate regions. In the last stage, he located the license plate exactly with some morphological operators [8]. Chen et al. (2007) in his study, a novel method to recognize license plates robustly is presented. First, a segmentation phase locates the license plate within the image. Then, a procedure based upon feature projection estimate needs to separate the license plate into seven characters. Finally, the character recognizer extracts some salient features of characters and uses template-matching. Ebrahimi et al. (2007) He proposed a new algorithm for vehicle license plate location on the basis of multi agent systems. The algorithm was tested with 400 natural-scene gray level vehicle images of different backgrounds and ambient illumination.

The license plates properly segmented about 99% images [10]. Xiaodan et al. (2007) He proposes a novel algorithm for character segmentation of degraded license plate based on prior knowledge. Firstly, this algorithm performs preprocessing on the license plate then, locates the character segments according to the vertical projection and finally, segments the characters according to the number and the width of the character segments. This algorithm is more

efficiency under the condition that the license plate images are degraded, such as declining, faded, distorted, fogged, etc, quality degradation license plate [11]. Chen et al. (2007) In his study, a novel method to recognize license plates is presented. The proposed method has three main phases, in the first phase segmentation is done to locate the plate, then feature projection is used to separate the seven characters and finally character recognizer extracts the feature points [12]. Deb et al. (2008) His paper describes a new approach to analyze road images which often contain vehicles and extract license plate (LP) by finding vertical and horizontal edges. In the proposed method, input vehicle images are converted into gray images. After then the candidate regions are found by sliding concentric windows. He detected vehicle license plates (VLP) by using HSI color model and LP alphanumeric character by using position histogram. Experimental results showed that the proposed method is very effective [13]. Shishir et al. (2008) His work deals with the construction of license plate recognition system for Indian vehicle (LPRSIV). He included various mathematical principles and algorithms, which ensure processes of license plate normalization, character segmentation and recognition. His work also contains few snapshots as example to understand the system and its functions [14]. Manoj et al. (2012) He described several edge detection operators like Sobel, Prewitt, Canny, Roberts, Zero threshold and emergence of combination of different spatial edge detection method, and its matlab simulation studies. He concluded that for text recognition combine edge detection method locates the edges better compared to other classical edge detectors [34]. Nadernejad et al. (2008) He compared several techniques for edge detection in image processing. He considered various well-known measuring metrics used in image processing applied to standard images in this comparison [15]. Yasin et al. (2009) He said travel time is a basic performance measure of the developed transportation system. He developed a new real-time ANPR system to suit with traffic environment in Malaysia.

The development of the ANPR system consists of several processing steps such as vehicle detection, number plate localization and extraction, character segmentation and recognition. On the basis of results, the system is reliable and robust and its capability to measure travel time indicated that it has huge potential to be used in traffic and transportation studies [16]. Maini et al. (2009) He presented the comparative analysis of various Image Edge Detection techniques using MATLAB 7.0. He showed that the Canny's edge detection algorithm performs better than all these operators. He observed that under noisy conditions Canny, LoG (Laplacian of Gaussian), Robert, Prewitt, Sobel exhibit better performance, respectively and Canny's edge detection algorithm is computationally more expensive compared to LoG (Laplacian of Gaussian), Sobel, Prewitt and Robert's operator [17]. Saha et al. (2009) In his work, he concentrated on localization of license plate regions from true color still snapshots captured in a very realistic situation. He used a technique which is based on a novel multi-stage approach for analysis of vertical edge gradients from contrast stretched gray-scale images [18]. Kim et al. (2009) He used a character segmentation method for license plate with topological transform such as twist, rotation. The first step is to find a candidate region for character and license plate. Then the evaluation of detected region is done using topological relationship between each character. When this method decides license plate candidate region, character features in the region with binarization are used. A number of test images are used to evaluate the results [19].Moravcik et al. (2009) He said that task of image segmentation is a first step in many computer vision methods. His work deals with image segmentation methods with application in programming environment Matlab. He described some chosen algorithms and their advantages and disadvantages [20]. Zakaria et al. (2010) He presented a method for Malaysian car number plate detection system.

This method utilizes template matching technique to approximate the location of the number plate region. Then colour information is used to eliminate the unwanted colour areas without affecting the correct colour regions [21].

Al-amri et al. (2010) He presented methods for edge segmentation. He used seven techniques: Sobel operator technique, Prewitt technique, Kiresh technique, Laplacian technique, Canny technique, Roberts technique and Edge Maximization Technique (EMT) and these methods are compared so as to choose best one for the satellite images [22]. Musoromy et al. (2010) He compared various edge detection techniques and their performance when applied in license plate detection using an embedded digital signal processor. The edge detection algorithms compared in this work are Canny-Deriche-FGL, Haar and Daubechies-4 wavelet transform and the classic Sobel. These particular algorithms are chosen and compared due to their good performance on digital signal processors. The comparison is drawn in terms of speed and detection success of a license plate and results show Haar wavelet-based edge detector performs better on a DSP [23]. Paunwala et al. (2010) His work mainly deals with the detecting license plate location issues in Indian traffic condition. Proposed method aims at identifying region of interest by performing a sequence of directional segmentation and morphological processing. The first step is of contrast enhancement, then connected component analysis followed by different filtering techniques like aspect ratio analysis and plate compatible filter technique is used to find exact license plate [24]. Suri et al. (2010) He detected the number on vehicle plates in the input image. He used simple color conversion, edge detection and connector measurement technique. The best results can be obtained by getting the value of connector components more than 17.The image is stored in the form of a matrix and the output is displayed in the form of detected numbers. In his work he used sobel edge detection [25]. Anishiya et al. (2011) He proposed a number plate localization and recognition system for vehicles in Tamil Nadu (India).The proposed algorithm is based on a combination of morphological operation with area criteria tests for number plate localization. Segmentation of the plate characters was achieved with edge detectors, labeling and fill holes approach. The character recognition was accomplished by the process of Template matching.

The system was experimented with four different edge detectors namely Sobel, Canny, Prewitt, LOG. A comparative analysis on the success rate of the proposed system showed overall better success rate of 96.8% by using canny edge detector [26]. Lakshmi et al. (2011) she designed an efficient automatic authorized vehicle identification system by using the vehicle number plate. Location of the license plate is performed using its inherent texture characteristics and wavelets. Character segmentation is done using Connected Component Analysis and character recognition of the vehicle license plate based on template matching. This system is implemented using MATLAB [27]. Kranthi et al. (2011) He presented a recognition method in which the vehicle plate image is obtained by the digital cameras and the image is processed to get the number plate information. A rear image of a vehicle is captured and processed using various algorithms. In this context, the number plate area is localized using a novel, feature-based number plate localization method. He mainly studied two fast algorithms i.e., Edge Finding Method and Window Filtering Method for the better development of the number plate detection system [28]. Langote et al. (2012) He used fuzzy methodology for efficient threshold selection which produces better segmentation results than other methodologies [31]. Sivanandan et al. (2012) His proposed algorithm consists of three major parts: Extraction of plate region, segmentation of characters and recognition of plate characters. He used edge detection and morphological operations for extracting the plate region. Optical character recognition technique is used for the character recognition [32]. Jaskirat et al. (2012) she analyzed different geo satellite images, medical images and architectural images by using image segmentation (thresholding and edge detection) techniques. A comparison of thresholding, different edge detection techniques on images from different fields has been done. Observation was made that each type of image has different area to be analyzed. Images were examined using different techniques and the ones providing accurate results were identified [33].

4. THE PROPOSED METHODOLOGY

4.1 Preprocessing

Preprocessing is very important step for the better performance of character segmentation of LPR. In this step, the image is converted into grayscale image. The main reason for doing preprocessing is to perform image enhancement to highlight the desired region in the processed image. There are two types of license plate in India i.e. one in yellow background and other in white background with black characters in both types.

Figure 1: Grayscale Image of License Plate

4.2 Edge Detection

Mainly, we use the Sobel operator to detect the vertical edges because it preserves majority of edge information in the plate area while it removes lots of horizontal edges around the LP reults in localization process easier and the computational time of Sobel operator is low. The computation of the partial derivation in gradient may be approximated in digital images by using Sobel operator. A convolution mask is used is usually much smaller than the actual image. As a result, the mask is slide over an area of the input image, changes that pixel's value and then shifts one pixel to the right and continues to the right until it reaches the end of a row. It then starts at the beginning of the next row. The center of the mask is placed over the pixel you are manipulating in the image. And to multiply, the values are used to move the file pointer. After the edges are detected, a binary edge map is obtained by adaptive binarization.

4.3 License Plate Localization

There are two facts that attract our attention: one is that the texture information of LP region is different from the other regions in the edge-detected image, such as the edge numbers in a specific window and in the horizontal direction; the other is that the hue of the yellow is insensitive to lighting condition change. Thus we locate the license plate by the combination of edge, texture and color information.

4.4 Character Segmentation

Once the Vehicle license plate has been successfully localized, character segmentation process will be performed on the result. For character segmentation, the mainly used methods are static bounds, vertical projection and connected components. To simplify the process of identifying the characters, it is desirable to separate the extracted plate into several images. Then each character will be classified as a connected component.

Figure 2: Segmented Characters

4.5 Character Recognition

The license plate contains any character from A to Z and number from 0 to 9. The license plate contains the combination of characters and numerals. The first two letters on the license plate indicates the state to which the vehicle is registered. The next two digit numbers indicates the state to which the vehicle is registered. The next two numbers indicate the sequential number of a district. The third part is a four digit number unique to each plate. To recognize the license plate region, OCR (Optical character recognition) algorithm based on template matching and artificial neutral network are used currently.

5. CONCLUSIONS AND FUTURE SCOPE

This paper presents a simple license plate detection technique from license plate images to generate more reliable and accurate location under ambiguity effectively and efficiently. The proposed technique can detect the license plate with non-yellow background. In future, we can detect the license plate with yellow background with maximum precision detection rate and we can develop a single technique that is suitable to recognize all the applications.

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